

**EUROPEAN PATENT SPECIFICATION**

- (45)** Date of publication of patent specification: 06.03.85      **(51)** Int. Cl.<sup>4</sup>: F 21 P 3/00, A 63 J 17/00,  
G 09 F 27/00
- (21)** Application number: 79302703.8
- (22)** Date of filing: 27.11.79

**(54)** Audio-visual display system.

- |  |   |
|--|---|
| <p><b>(44)</b> Date of publication of application:<br/>03.06.81 Bulletin 81/22</p> <p><b>(45)</b> Publication of the grant of the patent:<br/>06.03.85 Bulletin 85/10</p> <p><b>(46)</b> Designated Contracting States:<br/>AT BE CH DE FR IT LU NL SE</p> <p><b>(50)</b> References cited:<br/>FR-A-2 232 171<br/>GB-A- 968 822<br/>US-A-1 977 997<br/>US-A-3 806 722<br/>US-A-3 958 113<br/>US-A-4 164 823</p> | <p><b>(78)</b> Proprietor: INGORD LIMITED<br/>3 South Bridge<br/>Edinburgh 1, Scotland (GB)</p> <p><b>(72)</b> Inventor: Prangley, Gordon Noel<br/>10 Church Street<br/>Widcombe Hill Bath, Avon (GB)</p> <p><b>(74)</b> Representative: Armitage, Ian Michael et al<br/>MEWBURN ELLIS &amp; CO. 2/3 Cursitor Street<br/>London EC4A 1BQ (GB)</p> |
|--|---|

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European patent convention).

Courier Press, Leamington Spa, England.

**EP 0 029 474 B1**

**BEST AVAILABLE COPY**

## Description

This invention relates to audio-visual display systems, and more particularly to systems in which the production of music or other sound is accompanied by the production of images on a screen in response to the sound.

An audio-visual display system of this kind may comprise a plurality of channels each having a filter unit to provide an electrical output signal in response to a selected band of audio frequency input, the different channels being responsive to different bands and connected to separate lamps or sets of lamps which are arranged to project different images onto a viewing surface of a screen, whereby the different images are produced in response to variations in audio frequencies supplied to the filter units.

An important part of the system of the present invention is the final display part, since the quality of the system will be judged by the subjective impression of the images which the viewer receives.

British patent specification 968,822 discloses a display system which includes a plurality of coloured lights spaced forwardly of a screen. Objects (e.g. trees) are located between the lights and the screen so as to cast multiple coloured shadows onto the screen.

French patent publication 2,232,171 discloses display systems in which pluralities of light sources are covered or enclosed by diffusers. An observer views part of the outer surface of a diffuser.

Both of the above-mentioned documents refer to the possibility of controlling the lights in response to the frequency distribution of an audio input. Of course the two differ substantially in the nature of the final display. The former discloses a display suitable for stage lighting, requiring an auditorium in which the lights and objects can be located suitably far in front of the screen. The latter provides displays of diffuse, coloured light on the exterior of a diffuser whose extent is scarcely greater than that of the light sources which it covers.

An audio-visual display system according to the present invention is characterised in that the screen has a concave surface, and the lamps are disposed around the periphery of the screen adjacent the surface thereof so as to project the images across the surface. The concave surface is preferably parabolic. The lamps are preferably arranged around a sector of the periphery, whereby the images appear to emanate from that sector. However, they could be arranged at the centre of the screen so as to radiate the light outwardly across the surface.

At least some of the lamps preferably incorporate non-laminar coloured light-transmitting elements of glass, crystal, or preferably gemstones, through which the light passes so as to provide coloured patterned images by refraction or from natural internal striations in the element. Preferably the lamps are of at least two sorts; one sort

incorporating elements as described above, and another sort providing a relatively diffuse image by transmission of light through coloured sheet filters (the sheet being separate from the lamp or part of the lamp envelope itself). Another sort of lamp may provide coloured light emanating from one or more openings in a generally opaque lamp housing the openings being small in relation to the lamp so as to provide relatively narrow beams of light. The lamps are preferably arranged so that highest and lowest audio frequencies are predominantly in the central region of the display, while the intermediate frequencies are predominantly represented by lamps producing images in the outer regions of the display or distributed over the area of the display. Preferably the lamps incorporating said elements are used predominantly for the middle to higher range of audio frequencies, and lamps producing other images are used for the lower frequency range and possibly also for the highest frequency range. Preferably also the lamps are arranged in at least two rows at different distances from the surface of the screen.

The filter units of the system can be arranged so that the audio frequency response of adjacent channels overlap each other, preferably to produce as nearly as practicable a smooth response over the audio frequency spectrum.

The system may include an amplifier unit arranged to vary the intensity of illumination in response to the amplitude of the audio input signal. There may also be an automatic gain control to limit the output signal to the lamps and compensate for non-linear response of the lamps to variations in current. Additionally or alternatively the amplifier may have a logarithmic response, arranged to compress the dynamic range of the audio signal.

There may also be provided a limited amount of background illumination on the screen, so that the images do not appear on a totally dark background. The apparatus may therefore include a lamp providing an overall relatively low level of illumination of the screen.

In order that the invention may be more clearly understood, various embodiments will now be described with reference to the accompanying drawings, wherein:

Fig. 1 shows a perspective view of the display part of one embodiment of the apparatus, as seen by a viewer;

Fig. 2 shows a perspective view of part of the rim of the display screen of Fig. 1;

Fig. 3(a) to (d) shows different sorts of lamp housings; and

Fig. 4 is a schematic diagram of electronic circuitry for the apparatus.

Referring to the drawings, and firstly to Fig. 1, the screen comprises a shallow dome 14, which is arranged horizontally above the viewer; for example, it may be set in the ceiling of a room or suspended from the ceiling. The dome is preferably of parabolic curvature. An upwardly opening trough 15 extends around the periphery of the

dome, and in a sector of the trough (marked A—A in Fig. 1) are mounted the lamps. Typically, this sector may extend around one third of the circumference. The trough thus prevents the lamps from being seen directly by the viewer, but its open top allows the light to be projected onto the screen. Well below the dome there may be provided a lamp 16 on a stand 17, arranged to throw a circular pool of light over the area of the dome. However this feature is optional and may be omitted if desired. It is intended to provide a very low level of illumination of the dome when the sound signal is zero.

Referring to Fig. 2, the lamps 18 are arranged in the trough in three rows X, Y and Z, at different distances from the surface of the dome. Those nearest the surface, in row X, direct their light across the surface of the dome, producing elongate images, whereas those furthest from the surface, in row Z, direct their light at the surface of the dome producing more localised and sometimes sharper images.

Fig. 2 shows various sorts of lamp housing which are more particularly illustrated in Fig. 3. In Fig. 3(a) the bulb 19 is carried in a conventional holder 20a which can be mounted within the trough 15 using suitable brackets (not shown). A cylindrical housing 20 fits slidably over the bulb. The sides of the housing are opaque, but the end 21 is open or covered by a light transmitting sheet, which can be coloured (if the bulb itself is not coloured) so that an unfocussed shaft of coloured light emerges from the end 21. Fig. 3(b) shows an alternative housing in which the end 21 is closed by a wall having an aperture in which is fitted one or more light-transmitting elements 22 of coloured glass, crystal or gemstone. Gemstones are preferred because they have internal striations which provide distinct patterns on the surface of the dome. Typical gemstones for this purpose are ruby, topaz, aquamarine, alexandrite, amethyst, garnet, peridot, spinel, sapphire and emerald. The stones are preferably cut and may be mounted with the flat face outwards or inwards to give different effects. Fig. 3(c) shows an alternative housing in which the end 21 is closed and narrow slots 23 or other small openings are provided in the walls giving relatively narrow beams of light. Fig. 3(d) shows an alternative housing in which the end 21 is closed and a relatively large opening 24 is provided in the side wall to give a more diffuse beam of light. The lamps are arranged at various angles in the trough 15, as suggested in Fig. 2, to give desired images on the surface of the dome. The housings can be rotated to adjust the images.

The electronic circuitry for controlling the lamps 18 in accordance with an audio input signal can be generally conventional. A suitable arrangement is shown in Fig. 4. The audio signal (e.g. from a gramophone, tape recorder, radio or microphone) is supplied at an input 30 to a preamplifier 32, which has a logarithmic response in order to compress the dynamic range of the audio signal, so that a pleasing display is seen for

both loud and quiet inputs, and to limit the output to the lamps and to account for non-linear response of the lamps to variations in current. Additionally or alternatively, the preamplifier 32 may have an automatic gain control for similar reasons.

The audio signal is now split into a plurality of parallel channels, each sensitive to a particular frequency band. The number of channels can vary. For example, there may be twelve channels, each driving several of the lamps. The best results are obtained, however, with a large number of channels, such as forty-eight, each responsive to only a comparatively narrow band of the audible spectrum and each driving only one or perhaps two of the lamps. Each channel has a filter 36 by means of which the frequency band to which that channel is responsive is set. Where there is a large number of channels, the bandwidth of a channel is preferably relatively narrow, and some or all channels may respond to only one or two notes of the musical scale. However, advantageously the bandwidth is a little wider than about a semitone or tone, to allow for variations in the accuracy of tuning of the input signal. A bandwidth of 1/8 octave may be suitable. Preferably the response of the filter falls away sharply at the edges of the desired frequency band, and preferably there is a slight overlap between adjacent frequency bands.

From these requirements, clearly a filter with a high value of Q is desirable. The exact parameters of the filters can be variable, to permit presetting of the system to give best results.

The filter 36 is preceded by an amplifier 34. The gain of this amplifier is variable so that the overall level of the lamps driven by each channel can be preset. The filter is followed by an AC to DC converter 37, which rectifies the audio signal to give a DC signal dependent on the amplitude of the audio signal. This DC signal controls the length of the unstable period of a monostable 38, which acts on a triac lamp control circuit 42 through a trigger amplifier 40 in well known manner. The triac supplies current to the lamp for a proportion of the mains AC cycle which is controlled by the duration of the unstable period of the monostable. The brightness of each lamp 18 thus varies with the amplitude of the audio signal in the corresponding channel.

A rough indication of the kind of display produced is shown at 16 in Fig. 1. The beams of light emanate from the sector of the dome periphery opposite the viewer and spread out across the dome in patterns determined by the type and arrangement of lamp housings used and the nature of the sound input. At low volume, the images are concentrated near the source of the lights, and as the sound dies away the images seem to disappear into the edge of the dome. Housings of Fig. 3(b) type are generally used for the middle and higher frequencies, usually in rows Y and Z to produce relatively sharp images of interesting patterns, whereas Figs. 3(a), (b) and (d) type lamps are generally used for the lower

frequencies and may also be used for the highest audible frequencies. In this way, the sharpest images are produced with the most distinctly audible notes. Also, the highest and lowest frequencies are represented by images predominantly in the central region of the array of lamps, while the middle range of frequencies is represented by images in the outer regions or distributed across the screen.

The screen could be of various other concave shapes, for example that of a shell. The concavity of the surface (i.e. curving concavely in all directions) provides a more even illumination within each image. That is, the decrease in intensity of illumination is less dependent on the distance from the lamp source than would be the case with a flat screen. The concave screen can be arranged to be mounted in any desired position. For example the screen could be mounted in the angle between the ceiling and wall of a room, especially between the two speakers of a stereophonic sound reproduction system. In this case the lamps could be arranged so that images appear more on one side than the other according to which direction the sound appears to be coming from. Particular filter channels could thus be linked to different channels of the stereo system, for example, a 48-filter channel system having 24 filter channels for each stereo channel. Other arrangements of screen are between the angle of the ceiling and two walls, on one wall or in the angle between two walls, in the angle between two walls and the floor, or even on the floor facing upwardly. Use could even be made of the existing walls or ceiling by providing a relatively small or narrow concave screen and allowing the images to spill over onto the wall or ceiling.

Various controls can be provided on the equipment for operation by the user, for example the equivalent of volume, treble and bass controls for the lighting, so that the general intensity of the lighting can be altered using the "volume" control, and the light intensity response at high and low frequencies can be altered using the "treble" and "bass" controls. Further, a control may be provided to alter the linearity of the light response. Also a bandwidth control may be provided to spread or reduce the band width of each channel, so that a channel may respond to a single note or to a number of notes. Furthermore, a bandswitch control may be provided so that the lights can be switched from one channel to another. In this way the frequencies represented by the different lamps can be changed, giving a totally different sequential display from a given audio performance.

Another feature is to provide a manual control which can be operated to provide an input progressing steadily across the audio frequency range so that the operation of the lamps can be checked before the performance. An automatic sweep oscillator can be provided to give, on selective operation or automatically after termination of a performance, a randomly or pseudo-randomly changing frequency input to provide a changing

output from the lights, for example when there is no performance taking place.

#### Claims

1. An audio-visual display system comprising a plurality of channels each having a filter unit (36) to provide an electrical output signal in response to a selected band of audio-frequency input, the different channels being responsive to different bands and connected to different lamps (18) or sets of lamps which are arranged to project different images onto a viewing surface of a screen (14), whereby the different images are produced in response to variations in audio-frequencies supplied to the filter units, characterised in that the screen (14) has a concave surface, and the lamps (18) are disposed around the periphery of the screen (14) adjacent the surface thereof so as to project the images across the surface.

2. An audio-visual display system according to claim 1 wherein the lamps (18) are arranged around a sector (A—A) of the periphery, whereby the images appear to emanate from that sector.

3. An audio-visual display system according to any one of the preceding claims wherein at least some of the lamps (18) incorporate non-laminar coloured light-transmitting elements (22) through which the light passes so as to provide coloured patterned images by refraction or from natural internal striations in the element.

4. An audio-visual display system according to claim 3 wherein at least some of said non-laminar elements are of glass, crystal or gemstones.

5. An audio-visual display system according to claim 3 or claim 4 comprising a first set of lamps incorporating said non-laminar elements, and a second set of lamps providing a relatively diffuse image by transmission of light through coloured laminar filters.

6. An audio-visual display system according to any one of claims 3, 4 and 5 comprising a set of lamps which provides coloured light emanating from one or more openings (23) in a generally opaque lamp housing, the openings being small in relation to the lamp so as to provide relatively narrow beams of light.

7. An audio-visual display system according to any one of claims 4 to 6 wherein lamps incorporating said non-laminar elements are used predominantly for the middle to higher range of audio-frequencies, and lamps producing other images are used for the lower frequency range and optionally also for the highest frequency range.

8. An audio-visual display system according to any one of the preceding claims wherein the lamps are arranged so that those representing the highest and lowest audio-frequencies are predominantly in the central region of the display, while the intermediate frequencies are predominantly represented by lamps producing images in the outer regions of the display or distributed over the area of the display.

9. An audio-visual display system according to any one of the preceding claims wherein the lamps are arranged in at least two rows (X, Y, Z) at different distances from the surface of the screen.

#### Revendications

1. Système d'affichage audio-visuel comprenant une pluralité de canaux ayant chacun une unité de filtre (36) pour produire un signal de sortie électrique en réponse à une bande sélectionnée de fréquence auditive d'entrée, les différents canaux répondant à différentes bandes et étant reliés à différentes lampes (18) on jeux de lampes qui sont disposées de manière à projeter des images différentes sur une surface de vision ou sur un écran (14), dans lequel les différentes images sont produites en réponse aux variations de fréquences auditives délivrées par les unités de filtre, caractérisé en ce que l'écran (14) présente une surface concave, et que les lampes (18) sont disposées autour de la périphérie de l'écran (14) à proximité de sa surface de manière à projeter les images au-travers de cette surface.

2. Système d'affichage audio-visuel selon la revendication 1, dans lequel les lampes (18) sont arrangées autour d'un secteur (A—A) de la périphérie, de sorte que les images apparaissent comme provenant de ce secteur.

3. Système d'affichage audio-visuel selon l'une des revendications précédentes dans lequel au moins certaines des lampes (18) comprennent un élément coloré non laminaire transmettant la lumière (22) à travers lequel la lumière passe de manière à créer des images tramées colorées par réfraction ou à partir d'une striation interne naturelle dans l'élément.

4. Système d'affichage audio-visuel selon la revendication 3, dans lequel au moins certains de ses éléments non-laminaires sont en verre, en cristal, ou en gemme.

5. Système d'affichage audio-visuel selon la revendication 3 ou la revendication 4, comprenant un premier jeu de lampes présentant lesdits éléments non-laminaires et un second jeu de lampes créant une image relativement diffuse par transmission de lumière à travers des filtres colorés laminaires.

6. Système d'affichage audio-visuel selon l'une des revendications 3, 4 et 5, comprenant un jeu de lampes qui délivre de la lumière colorée émanant à partir d'une ou plusieurs ouvertures (23) d'un boîtier de lampe généralement opaque, les ouvertures étant petites par rapport à la lampe de manière à créer des rayons de lumière relativement étroits.

7. Système d'affichage audio-visuel selon l'une des revendications 4 à 6 dans lequel les lampes comportant ces éléments non-laminaires sont utilisées de façon prédominante pour les gammes de fréquence moyenne et haute, et les lampes produisant des images différentes sont utilisées pour la gamme de fréquence basse et éventuellement également pour la gamme des plus hautes fréquences.

8. Système d'affichage audio-visuel selon l'une des revendications précédentes selon lequel les lampes sont disposées de telle manière que celles représentant les fréquences auditives les plus hautes et les plus basses sont de façon prédominante disposées dans la région centrale de l'affichage tandis que les fréquences intermédiaires sont de façon prépondérante représentées par des lampes produisant des images dans les autres régions de l'affichage ou distribuées sur la surface de l'affichage.

9. Système d'affichage audio-visuel selon l'une des revendications précédentes dans lequel les lampes sont disposées suivant au moins deux rangées (X, Y, Z) à des distances différentes de la surface de l'écran.

#### Patentansprüche

1. Audiovisuelles Anzeigesystem mit einer Mehrzahl von Kanälen, von welchen jeder mit einer Filtereinheit (36) für die Erzeugung eines elektrischen Ausgangssignals als Reaktion auf ein ausgewähltes Band von audiofrequenten bzw. ton- bzw. niederfrequenten Eingangssignalen versehen ist, wobei die verschiedenen Kanäle auf verschiedene Bänder ansprechen und mit verschiedenen Lampen (18) oder Sätzen von Lampen verbunden sind, die verschiedene Bilder auf die Betrachtungsfläche eines Bildschirms (14) projizieren, wobei die verschiedenen Bilder als Reaktion auf die Variationen bzw. Veränderungen der den Filtereinheiten zugeführten Audiofrequenzen erzeugt werden, dadurch gekennzeichnet, daß der Bildschirm (14) eine konkave Fläche aufweist und die Lampen (18) um den Umfang des Bildschirms (14) herum angrenzend an seine Fläche angeordnet sind, um die Bilder quer über die Fläche zu projizieren.

2. Audiovisuelles Anzeigesystem nach Anspruch 1, dadurch gekennzeichnet, daß die Lampen um einen Sektor (A—A) des Umfanges herum angeordnet sind, so daß die Bilder von diesem Sektor auszugehen scheinen.

3. Audiovisuelles Anzeigesystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß wenigstens einige der Lampen (18) mit nichtlaminaren, farbigen Lichtübertragungselementen (22) versehen sind, durch welche das Licht durchgeht, um farbige gemusterte Bilder durch Brechung oder durch die natürliche innere Streifung im Element zu erzeugen.

4. Audiovisuelles Anzeigesystem nach Anspruch 3, dadurch gekennzeichnet, daß wenigstens einige der nichtlaminaren Elemente aus Glas, Kristall oder Edelsteinen bestehen.

5. Audiovisuelles Anzeigesystem nach Anspruch 3 oder 4, mit einem ersten Satz von Lampen, welcher die nichtlaminaren Elemente umfaßt und einem zweiten Satz von Lampen, der ein verhältnismäßig diffuses Bild durch Übertragung von Licht durch farbige laminare Filter erzeugt.

6. Audiovisuelles Anzeigesystem nach einem der Ansprüche 3, 4 und 5, dadurch gekennzeichnet,

net, daß es mit einem Satz von Lampen versehen ist, der farbiges Licht ausgehend von einer oder mehreren Öffnung(en) (23) in einem im allgemeinen undurchsichtigen Lampengehäuse erzeugt, wobei zur Erzeugung von verhältnismäßig dünnen Lichtstrahlen die Öffnungen klein im Verhältnis zur Lampe sind.

7. Audiovisuelles Anzeigesystem nach einem der Ansprüche 4 bis 6, dadurch gekennzeichnet, daß Lampen, welche die nichtlaminaren Elemente enthalten, vorwiegend für die mittleren und höheren Bereiche von Audiofrequenzen verwendet werden und Lampen, die andere Bilder erzeugen, für den unteren Frequenzbereich und gegebenenfalls auch für den höchsten Frequenzbereich verwendet werden.

8. Audiovisuelles Anzeigesystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Lampen so angeordnet sind, daß sich jene, die die höchsten und tiefsten Audiofrequenzen darstellen, vorwiegend in der zentralen Zone der Anzeige befinden, während die mittleren (Zwischen-)Frequenzen vorwiegend vom Lampen dargestellt sind, die Bildet in den äußeren Zonen der Anzeige erzeugen oder Bilder, die über den gesamten Bereich bzw. die gesamte Fläche der Anzeige verteilt sind.

9. Audiovisuelles Anzeigesystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Lampen in wenigstens zwei Reihen (X, Y, Z) in verschiedenen Abständen von der Oberfläche des Bildschirms angeordnet sind.

20

25

30

35

40

45

50

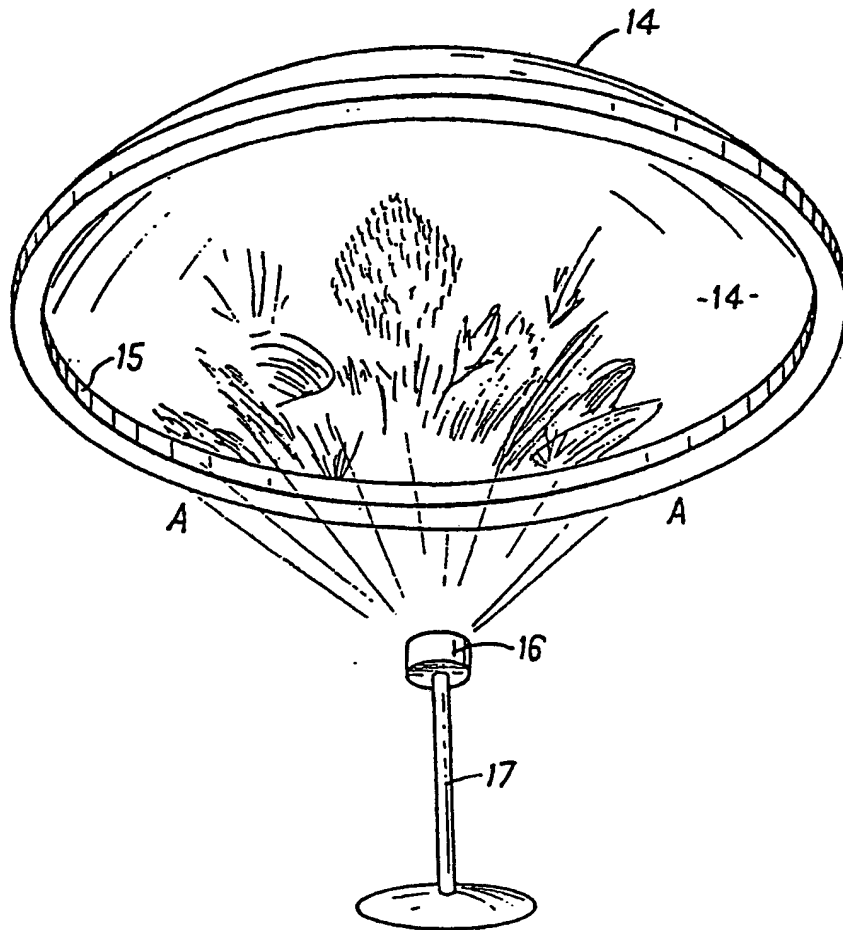
55

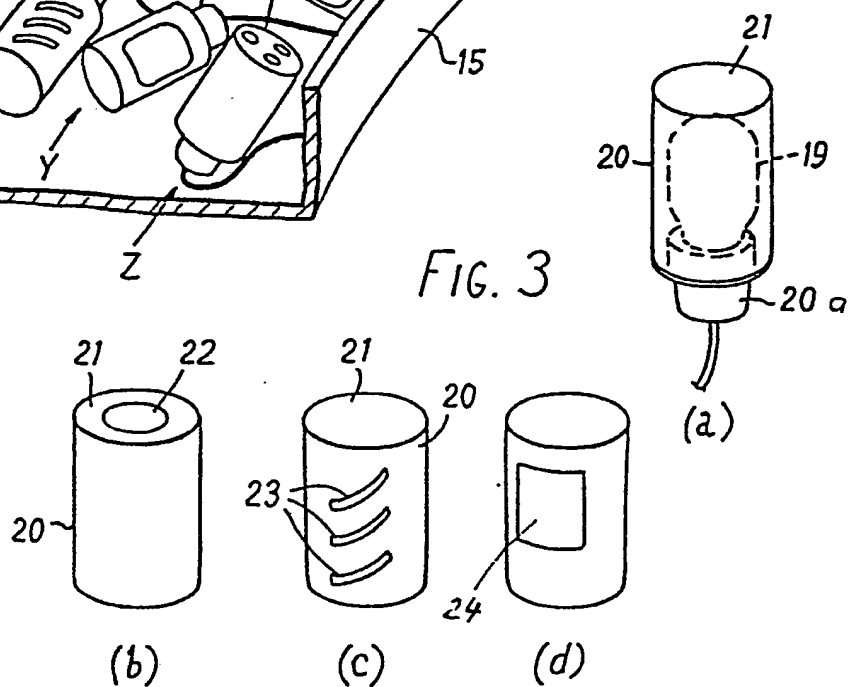
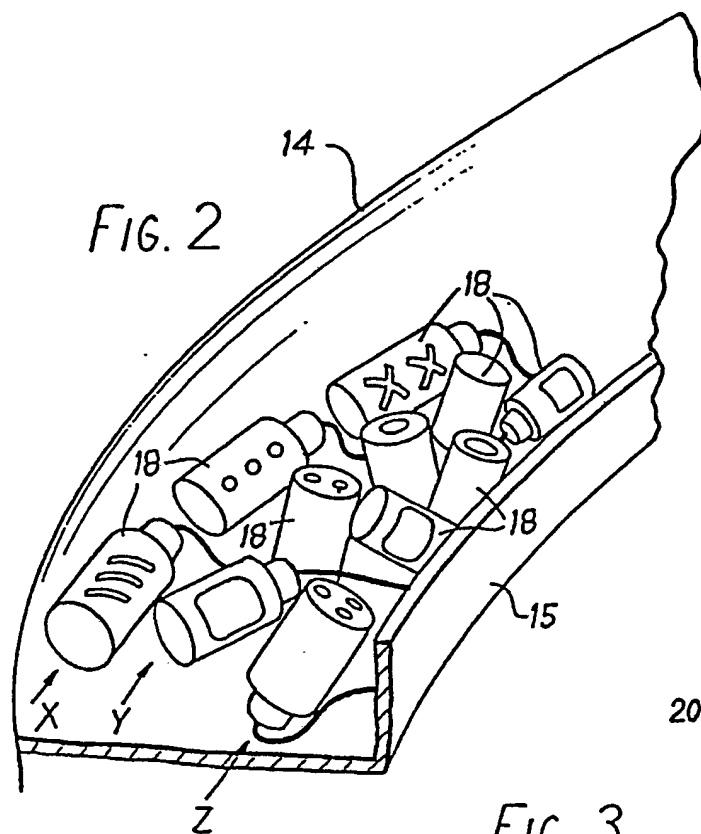
60

65

6

FIG. 1







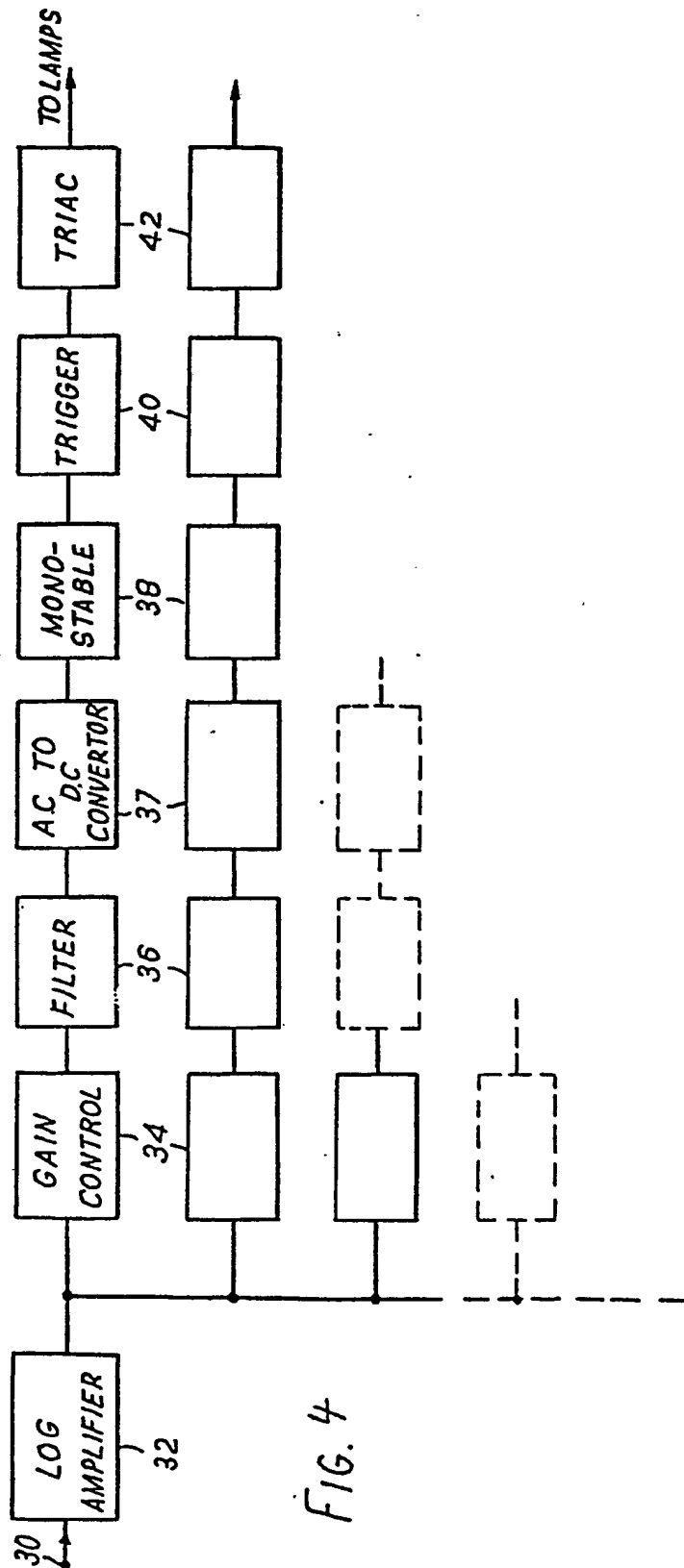


FIG. 4